

MOULTRIE (JAS.)

On the organic functions
of animals



Fig: 1.

Pulmonic
System.

Fig: 2.

Syst^c
Syst^m

Pul:
Syst^m

Fig: 3.

Syst^c
Syst^m

Pul:
Syst^m

Fig: 4.

Syst^c
Syst^m

Pul:
Syst^m

Lym. Sys.

Fig: 5.

Alimentary Apparatus.

Fig: 6.

Venous

System.

Liver:

Portal
veins.

Stomach
Intestine.

*Depuratory Organs of Arterial System
or
Ureosis*





ON THE
ORGANIC FUNCTIONS
OF
ANIMALS.

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CHARLESTON, S. C.:

BURGES & JAMES, PRINTERS,

No. 143 MEETING-STREET.

1844.

A

CHEMICO-PHYSIOLOGICAL DIAGRAM;

Or, A subjective idea of the Organico-Animal Functions rendered Objective. By Jas. MOULTRIE, M. D., Professor of Physiology, in the Medical College of the State of South-Carolina. (With a plate.)

In the year 1827, in an Essay on the "Uses of the Lymph," published in the American Journal of the Medical Sciences, among other things, attempted to be sustained, will be found the following Chemico-Physiological Doctrines. 1. The lacteals and lymphatics, do not constitute, as they are supposed to do, the absorbent system of the animal economy; they do not, as the absorbent theory supposes, remove from the organs the "cast off molecules" of which they are composed, or carry out of the body the "effete" particles disintegrated by the act of the assimilative function. The one is engaged in the preparation and introduction of chyle, and chyle only, into the blood; the other in elaborating an organizable product—a recrementitious secretion destined to unite with it for objects of a common and nutritious nature. 2. The primary object of the lymph, and that for which it is made to commingle with the chyle in the thoracie duct, is the vitalization of the latter fluid. 3. The truly "effete" matter of the body is the carbonaceous element of the venous blood, to which may be added the urea or azotic element of the urine. Than these, we know of nothing to which that term can be applied. 4. The venous and not the lacteal or lymphatic system, therefore, is the "absorbent system," in any disintegratory or effete sense of the phrase. 5. Nature, in effecting the elimination of excrementitious matter from the constituency of the solid or fluid parts, appears to aim at restoring to the physical universe, the matter temporarily borrowed for subsistence, in a state of elementary

iplicity, or an approximation thereto; that is, the carbon as carbon, the azote, as azote, and hydrogen, and oxygen, as hydrogen and oxygen. The lungs, she uses as one medium of escape; the kidneys, as a second; and, the skin, as a third, &c. Hence, the carbonic acid gas of respiration; the urea of the kidneys; and, the aqueous exhalations of the skin, pulmonary transpiration, and urine.

These doctrines, enforced by other considerations, and further amplified and elucidated, have been regularly introduced, in the course of lectures on Physiology, delivered by the Author, since the establishment of the College in 1833. It is with no little satisfaction, therefore, that he has seen them lately advanced in Europe, under circumstances better calculated to establish their verity. It is with the same satisfaction, too, he perceives that his notions respecting the uses of the lymph, are those which have been also adopted by Dr. Carpenter, in his work on the "Principles of General and Comparative Physiology," and that the other points of the inquiry have also received corroboration, as well as greater extension and verification, from the able pen of Prof. Leebig, in his more recent publication, on "Animal Chemistry."

The encouragement given by this last consideration, has induced him to republish them, accompanied with such other remarks as the perusal of their works have suggested, or may have been the result of his own unaided reflections. These are offered in the form of a propositional series, accompanied with a monographic delineation, which, by furnishing a sensible object for the attention to rest upon, may be found to conduce towards their better understanding. The principal figure represents the mechanism of the human œconomy, as conceived by the mind of the author; an abstraction, or mode of conception, of the relative situations, connections, and incident influences and dependencies, secondary or immediate, of the organic functions. It is a visual expression of a mental type, aiming to separate the functional phenomena from the material; to disembody the specialized powers of the organization, from the accidents of structure or superaded peculiarities of anatomical form, with which they are naturally associated, and which, in many instances,

serve not only to complicate, but also to perplex, and often defeat inquiry.

The central figure is the heart; the loop to the right, the pulmonic vessels; and the loop to the left, the systemic. Intermediate to the pulmonic vessels, are the lungs, in the site of the lesser capillary vessels; and in the same relation to the systemic, is the site of the function of assimilation, or greater capillary. Between the heart and assimilation, in the track of the arteries, are the kidneys; and between assimilation and the heart, in the track of the veins, is the liver. The lungs and liver are depuratory organs of the venous blood, the former of the general venous, and the latter of the partial or abdominal; and the kidneys are depuratory organs of the arterial. From the seat of assimilation, or the general capillary system, arises the lymphatic system, proceeding to join the lacteal, and terminating in the heart; and from the alimentary apparatus, arises the lacteal, to pursue in turn a corresponding course and termination. From the alimentary tube, arises in an analogous manner, the portal venous system, entering into the liver, and connecting itself, by means of the hepatic branches, with the general venous.

Considering the heart as a centre, the entire outline may be conceived of as an imperfect circle, from which other results may be obtained as to form, by certain abstractions and alterations. If we remove the heart, join the ends of the loops, where they are separated by this process, and so arrange the linear portion of the figure which remains, as to make each part of the line equidistant from any given point, we shall have, according to the stage at which the transition may have advanced, fig. 1, or fig. 2. The organs of the life of nutrition, therefore, according to this mode of evolving their relations, may be said to constitute interspective portions of the circle, and to be situated in various parts of its circumference; their media of connection being the arteries and veins, forming the compliments of the figure.

The lymphatics are represented by a line on the left of fig. 3, as a tangent to a circle proceeding from assimilation; the lacteals, by another line, as a second tangent, in the opposite direction. Prolonged till they meet below, at the point of convergence, as in fig. 4, they represent the mechanism of the chylo-lymphatic ap-

paratus, which connects itself with the alimentary, by one of the lines, as in fig. 5, showing the relations of this last to the vascular system in general and its depuratory appendages.

Fig. 6, is an abstract from the principal figure, exemplifying the intermediate relations of the liver, to the portal and general venous system ; designed to show its special connection with the former as well as the more depuratory relations to the latter ; that though it is a purifier of venous blood in general, in the performance of that office it has a particular reference to the abdominal.

To the depuratory function of this latter organ—the liver—the term *choleosis* has been applied, as well as *ureosis*, to designate, in like manner, the analogous office of the kidnics ; terms, which will be employed in the future progress of this inquiry. Their introduction appears to be justified, not less by analogy, as in the use of the words *chylosis*, *lymphosis*, *venosis*, &c., than their own immediate brevity, and other technical conveniences of scientific procedure.

The propositional form has been given to the accompanying disquisition, for a variety of reasons, of which the most important, interesting to be mentioned, is, that it accords with what is intended to be the whole character of the inquiry—*inquiritorial*.

1. There are two modes of contemplating and investigating the phenomena of living matter : One by considering life in the abstract ; the other in the concretè. The abstract is ontological, and regards that principle as an essence ; the concretè, is observational, and views it in connection with, or as an attribute of, organization. The concretè is regarded as the only practical, and therefore, philosophical mode of procedure, or that by which any available results can be obtained.

2. Thus studied, organized bodies are manifested in two comparative states—the *ante-excitatory* state, and the *post-excitatory*. The former is exemplified by seeds, bulbs, tubers, eggs, hibernation of animals, and rest in general of the organs ; the latter after germination, incubation, and their consecutive increment or growth, transformations, and decay.

3. The passive is the natural precedent to the active state, often alternating with it, in after existence ; and the conversion of

the organized bodies from the passive condition into the active, or the result of the established relation, which has been instituted between stimuli and susceptibility ; the latter of which is inherent to organization. The stimuli, are caloric, air, light, water, electricity, and nourishment ; air and nourishment being those in particular which more especially relate to the objects of our research.

4. Philosophically speaking, both states are living ; though the signification of the term, as it relates to each, is not identical.

5. Physiologists have not sufficiently considered the philosophy of these two states. Their notices of life in general have, accordingly, been indiscriminative or obscure. Examples are evinced in the writings of Rush, of America, and Brown, of Scotland. Rush, after defining life to consist in motion, sensation, heat, and thought, says that in its lowest grade it probably exists without even motion ; from which it is to be inferred he probably had the comparatively passive state in view ; and, in another place repeats, after Brown, that it is a "forced state ;" which probably implies that both authors contemplated the comparatively active.

6. Remarkable examples of the passive, now and then occur, showing the practicability of its continuance, in some instances, and under certain circumstances, for indefinite periods of time, and the necessity as well as justness of the discrimination. Instance the hyacinth taken from a Catacomb of Egypt, which grew vigorously, according to Prof. Linley, when planted in the London Horticultural Society's garden ; and the "Mya Cariosa and Purpurea," turned out-of the bed of the Erie Canal, 40 feet below the surface, after 4000 years inhumation, which, according to Prof. Eaton, were alive, and eaten by the workmen who were engaged in the excavation. Were we to give an exclusive appellation to the term, it should be to susceptibility in the abstract ; that essence being vitality, or life, actual or potential.

7. Two observations are deducible from the discrimination just referred to : One, that the essence tends to self-accumulation, within certain indefinite limits, in the first state ; the other, to self-exhaustion, in the last. Hence the truth of a remark of Cuvier, that death is the necessary consequence of life ; and the ne-

gation of spring to high Northern latitudes, where summer so suddenly succeeds to winter.

8. To sustain organic bodies in the state of comparative activity, for their allotted duration, four constituent elements of animal compounds, viz.—oxygen, hydrogen, carbon, and nitrogen, are made to enter and escape the body.

9. Their mode of entrance is two-fold: through the channel of the lungs by inspiration, and through the digestive apparatus by alimentation.

10. Their mode of escape is multiplex: through the channel of the lungs by expiration, the skin by diapedesis, the liver by choleosis, and kidneys by ureosis.

11. They all enter in certain definite modes of combination, or in a given form; and make their exit in an analogous manner.

12. The form of entrance by alimentation, is as solids and liquids, constituting the carbonized and nitrogenized compounds of vegetable and animal food, and fluid matters of drink.

13. The form of entrance by inspiration, is as oxygen gas, of the atmospheric air.

14. The form of escape by the cutaneo-pulmonic channel is as elements in the state of water, a mode of combination which is also shared by the kidneys; by the liver, as bile—a carbo-nitrogenized product, according to Liebig; by the lungs, as carbonic acid gas; and by the kidneys, as urea—a nitrogenized product according to many. These several modes of escape constitute what are recognized as the functional actions of the skin and lungs—the cutaneous and pulmonic transpiration; choleosis, haematosis, and ureosis.

15. The actions or processes subservient, directly or secondarily, to entrance, make up the nutritive or composing series; those, in like manner, inservient to escape, the disintegrating or decomposing.

16. These two series—the composing and decomposing—have relations, direct and mediate, to one of the functions in the track of the circle, not yet named—the function of assimilation. The direct are to be regarded as its “proximate causes,” and partake themselves of the same composing and decomposing properties. They are the immediate nutritive, and the immediate disintegra-

ting ; two opposite, but congruously related modes of action ; together composing and constituting the generic function of assimilation. One of them is consequently directly subservient to life, the other indirectly.

17. The elementary constituents of animal compounds—oxygen, hydrogen, carbon and nitrogen—show a tendency to escape, in a form approximative of ultimate simplicity ; some effecting it more perfectly than others. Two of them appear to retain that in which they enter. The air expired is an approach to the simplicity of carbon-carbonic acid gas ; the urea of urine, an easily decomposable fluid, to the simplicity of nitrogen ; while the watery parts of this same fluid, the sweat and pulmonic transpiration, may be regarded as an illustration of the last, in which the oxygen and hydrogen, entering by alimentation, retain their pristine mode of combination.

18. Two of them, in their escaping form—carbonic acid gas, and urea—are poisonous as respects the tissues and organs, and cannot for that reason, be re-assimilated. They are abnormally related to vitality, or organic susceptibility, and need, therefore, to be finally or instantaneously ejected.

19. But these same two elements, in the form just noticed, are the only known disintegratory matter of the organization—the only true, discoverable effete matter, actually “cast-off,” from the substance of the body in notable quantity.

20. Therefore, if the theory of absorption, which physiologists have usually held of the lymphatics and lacteals be correct, they should constitute the chief ingredients of the lymph and chyle.

21. Observation shows, however, this not to be the fact ; but that they enter uniformly into the venous blood, and are carried, in part, to that portion of the arterial which is intermediate to the lungs and kidneys.

22. Commencing at assimilation, the site of the transformation of arterial into venous blood, or place of composition and decomposition, the venous, carrying along with it the poisonous elements just mentioned, experiences three physiological interceptions, by the liver, the lungs, and the kidneys ; and is subjected to

the respective actions of those organs, consecutively ; to wit, choleosis, hæmatosis, and ureosis.

23. By the first—choleosis—both elements are eliminated together, in combination, as bile ; by the second—hæmatosis— one of them alone, as carbonic acid gas ; and by the third—ureosis—the other, singly also, as urea and uric acid of urine.

24. From this it appears that the liver and the lungs—choleosis and hæmatosis—are the depuratory organs and functions proper to the venous system, while the kidneys—ureosis—are the depuratory organs and functions of the arterial. This consideration explains the peculiarity of their location, and the reason of their intermediation between the radicles, as they are anatomically called, of the opposing “vascular trees ;” one organ occupying the space appropriated to the portal capillaries, the others the pulmonic, and the renal.

25. The remaining capillaries constitute the site of assimilation ; the function, par excellence, to which all of the rest are tributary.

26. The functions enumerated, necessarily imply transformation ; a term which denotes intestine change among the particles of organizable and organized matter ; mutations of the relations of the chemical elements ; destruction of old, and reproduction of new animal compounds.

27. Assimilation and the other functions of the circle, are antagonistic not only as to locality, but modes of transformation ; that being from arterial into venous, this from venous into arterial blood. Assimilation, therefore, the end of the composing series, and beginning of the decomposing, is the point in the track of that circle, where the relations of priority and sequence, as they severally apply to each, are reversed.

28. Assimilation, however, is a generic and not a specific function ; appearing to be the basic element of several subordinate functions, or actions ; some constituting a composing division or series, others a decomposing. The former include nutrition proper, secretion, and lymphosis ; the latter colorification, excretion, and venosis. These, as well as the depuratory, require re-examination and investigation. We shall dwell, somewhat discursively, perhaps, upon each in turn.

29. Assimilation, generically understood, is the function in which the animal may be said, organically and emphatically, to live. And, therefore it is, that the entering and escaping processes, are, more or less directly or indirectly, subordinate to its transformations. Its laboratory, as we have said, is the systemic capillary system; the arterial blood is its material of elaboration; and the venous its repository of unused or disintegrated results.

30. The chemical constituents of the animal compounds, entering and escaping the body, derive their utility from their relation to assimilation; some of them having for their aim the maintenance of one or more of the actions or functions of one or both of the series, and some another. According to Liebig, they are intended for a two-fold purpose—nutrition and respiration. The last is a remote or consecutive relation, having a reference to their ultimate escape, after serving the more immediate purpose of their entrance: their immediate or direct, is, to assimilation. The oxygen of inspiration goes, for example, to administer, in common with the carbonaceous portions of the food, immediately to calorification; the nitrogenized portions of the same alimentary mass, and whatever it also may contain of hydrogen, to nutrition proper; and the oxygen and hydrogen, constituting the watery portions of the same—drinks—to serve as a means of solution and conduction to the animal compounds contained in the circulating fluids of the body, as well as to preserve the fluidity of the secretions and excretions. Hence the maintenance throughout, of their original form of entrance; the inapplicability, in a vital sense, to them, of the terms loss or gain; and probability, in fact, of their absolutely purely inorganic character. Liebig in reference to water, remarks, that it, as well as fat, is destitute of nitrogen, and they are, as his theory intimates, for that reason, amorphous or unorganized.

31. We need a better analysis than has yet been given of the phenomena of this function—assimilation. Physiologists have not given us a sufficiently clear or distinct exposition of its component elements. They do not seem to have determinate conceptions of the agreements and differences of nutrition proper, secretion, excretion, and their other associate functions. We shall for this reason, attempt one. According to the principles

thus far unfolded, and still further to be explained, they differ in a three fold manner: 1. as to elimination ; 2. as to organization ; and, 3. as to use.

32. Elimination is two-fold: immediate and consecutive. The elimination of carbonic acid gas, at the seat of assimilation, or the systemic capillary system, where it is formed by the immediate union of the oxygen of respiration and carbonaceous element of the food, is immediate elimination; its escape from the lungs, by the agency of respiration—a subsequent act—consecutive elimination.

33. Organization is also two-fold: diffused and specialized.—The diffused is that wherein all of the functions are performed in common: the specialized, wherein parts are separated or set apart, isolated as it were, for the performance of particular offices, as for example, an organ for a function.

34. Use is two-fold also: proximate, and sequential. The decarbonization, and denitrogenation, of the venous blood, is the proximate use of choleosis; the use which the bile subsequently subserves, as it respects Respiration, according to Liebig, or Alimentation, according to Tiedemann and Gmelin, its sequential.

35. Nutrition, with respect to the first—elimination—is one. It knows no distinction of immediateness and consecutiveness. It is wholly immediate. It is, with respect to the second—organization—both diffused and specialized: it is specialized in as much as it is a property of the systemic capillaries, separate from the other capillaries; and unspecialized or diffused, as it occupies the same system of vessels in common with all of the other functions of the assimilative series. And with respect to the third—use—it is proximate as well sequential. Its proximate, is the immediate reproduction of the particles disintegrated from the tissues and organs, or further developments of growth; its sequential, the contribution of elements which it furnishes to calorification, venosis, and the excretions.

36. Secretion also has no distinction of immediateness and consecutiveness. Like nutrition these are a unit. So also with respect to diffusion and specialization. It is diffused, in the sense in which nutrition is diffused, having a common seat in the systemic capillaries; and specialized in being isolated from the other capillaries. It also has a more particular specialization—

a specialization in a more technical sense of the term ; being restricted to the serous and synovial membranes, pancreas, and salivary glands. So also, as respects proximity and sequence. Its proximate use is various ; the serous and synovial having for their object the avoidance of friction between surfaces exposed to friction ; the pancreatic and salivary objects connected with the ends of alimentation. Its sequential, the supply of the materials immediately composing the excretions, such as the albuminous ingredients of the cutaneous and pulmonic exhalations, the follicular, &c.

37. Excretion, as respects elimination, is of a two-fold character : immediate and consecutive. Immediate elimination consists in the separation of the effete particles at the seat of assimilation, from the places which they previously occupied in the tissues and organs ; consecutive in their after escape from the pulmonic cells. The immediate, is a diffused or unspecialized function co-extensive, and consentaneous, as to activity in general, with nutrition proper ; the consecutive, a specialized one, the particular organic provisions or conditions for which are, the liver, the kidneys, the lungs, the cutaneous and pulmonary integumentation, &c. The first and the third—the liver and the lungs—the hæmotic and ureotic—have no distinction of proximate and sequential use ; the object of both being that of instantaneous or final ejection. The proximate use of the cutaneous and pulmonic, is the softening of the integumentation of the former, with a view to the perfecting of the relative functions, and the regulation of the animal temperature by both ; its sequential, ultimate freedom from unassimilative matter. The proximate of the second—the liver—choleotic—is, if the theory of the re-absorption of the bile, by Liebig be correct, the maintenance of hæmatosis and ureosis.

38. Lymphosis, another of the assimilative series, viewed by the light which these considerations cast upon the subject, is a composing, and not a decomposing function. It is allied to the secretions, and not to the excretions ; showing, in the derivation of the materials which compose the lymph, and in its situation as a function, a close resemblance to the pancreatic and salivary ; since all are products of the arterial blood—all are

composed of nitrogenized elements held in solution or suspension in water—and all, for that reason, capable of re-assimilation. Lymph, in fact, is a nitrogenized animal compound, free from admixture with carbonaceous elements, and therefore, not as, “water and fat are,” amorphous or unorganized, but at least, the reverse of that which they are represented to be. It, in an especial manner, is void of carbonic acid and urea—the ingredients so prejudicial or dangerous to assimilation or organic life, the disintegratory products of venosity; but is composed of elements identical with the “liquor sanguinis”—of water and albumen—and for that reason, as well as the foregoing, does not require to undergo depuration. Its return to the venous blood, at the heart, must have other objects in view than its own immediate purification: and this is manifest not less from what has been said, than inferences deducible from a due consideration of the apparatus, and the experimental tests, to which it has by many been subjected. The apparatus is a specialized one, denoting definiteness of purpose, and is compoitory rather than decompoitory; whilst experience shows that it uniformly refuses admittance to whatever is effete, foreign, or adventitious, the exceptions, if any, proving that they are anomalous results, or justifying the belief that their entrance is circuitous, rather than immediate or direct. Commonality of function, as a philosophical deduction, can only be inferred where there appears commonality of organization; as specialization also may be from an antagonistic consideration. Carpenter says, in his Principles of General and Comparative Physiology, published in London, in 1839,* it may be presumed the admixture of this highly elaborated fluid with the crude matter of the clýle has an important effect in assimilating the latter, and in preparing it to enter the general current of the circulation; an opinion in which he will find himself anticipated, as stated in the preliminary, in the Essay before referred to, in the volume of the American Journal of the Medical Sciences.

39. Venosity, on the other hand, is a disintegratory power, of the decomposing series: and the evidence of this is the reverse of the preceding. The veins alone, so far as experiment shows are,

the vessels which do receive, accommodate, and conduct to their own appropriate emunctories or depuratory organs, the components truly inimical and therefore entitled to be considered "effete." They alone, take up, indiscriminately, the varied and multifarious articles, with which their absorbent powers, together with those of the lymphatics and lacteals, have been so repeatedly tested. They alone contain the unassimilable products of decomposition, actually recognizable as such—the carbonic acid and urea. They alone, are the real absorbents, in the "effete" signification of the term ; the "scavengers," as the lymphatics are wont, in a fallacious sense, to be called, whose duty it is to remove from the body the "cast-off molecules" of the tissues and the organs.

40. Calorification, belongs, in like manner, to the decomposing series. It is closely related to venosis ; supplying this last, in part, with the very materials, which render the venous blood so decidedly hostile to the life of nutrition. Its sensible manifestation, is a result of the detachment of the carbonaceous matter of assimilation, as illustrated in the labours of Liebig, by the decomposing agency of the oxygen of respiration. Its proximate or climinary effect, therefore, is the removal, from the seat of assimilation, of the particles of matter which have become inutile or deadly from use.

41. These expositions, as far as we have advanced, furnish an explanation of the reason of the ordinal arrangement of the depuratory organs ; their being placed along the circumference of a circle as exemplified in the diagram. The following is the order of position : 1. Choleosis ; 2. Haematosis ; and 3. Ureosis.

42. The subserviency of choleosis to haematosis and ureosis, which has been already mentioned while teating of their proximate and sequential uses, together with many other considerations of a physical and anatomical nature, still further explain the cause of its intermediation, as a specialized function, between assimilation as it were, in the rear, and these two latter in the front. It is enabled, by this relation, to intercept the venous blood of the abdominal viscera ; to eliminate from it the bile ; and afterwards to transmit it to the general venous system, to be subjected to the laws by which it is in turn controlled. Choleosis,

therefore, has a special relation to the alimentary function: the liver, is the depuratory organ of the digestive apparatus. Bile, however, the product of choleosis, is a carbo-nitrogenized compound, composed as chemical analysis explains, of the basic elements of the matter of hæmatosis, as well as of ureosis. It combines, for that reason, the functional attributes of each, and identifies itself with them in some common use or end.

43. Its analogy to hæmatosis, as a de-carbonizing process, was remaked by Tiedemann and Gmelin, in their theory of the Uses of the Liver; and since the publication of their reflections upon it, the view has been favorably received by Physiologists. It has latterly met with a similar reception, as well as further corroboration, from Liebig. His ideas, however, of the sequential use of the bile, differ from theirs. They consider it as a co-essential of Alimentation; he, as having ulterior references to Respiration. In the view of the former, therefore, its natural outlet to the body is the intestinal canal; in that of the latter, the respiratory channels. In that instance, the form of its elimination is as bile; in this as carbonic acid gas. Neither of these ideas, it must be confessed, however, is unattended with difficulties. The colourless stools of jaundice, the fact that the combustive change, or combination of oxygen and carbon on which this depends, takes place in the systemic capillaries, and is consequently an assimilative and not a pulmonic act; together with the necessity of imputing supererogatory power, which the contrary theory supposes; are opposed to the hypothesis of Liebig: the average daily amount of faecal discharge, relatively to the reputed daily quantity of this fluid secreted; and absence from the former of "choleic acid and soda"—the essential constituents of the latter; to that of Tiedemann and Gmelin.

44. Its analogy to ureosis, as a deazotizing process, is a new observation, and for the first time, so far as known, here announced, as a determinate object of notice. We owe to the quantitative chemistry of Liebig, however, the analysis which has led us to present it in this corresponding connection,

45. The uses, as well as disposal, of the bile, proximate or final, constitute, therefore, a residuary order of phenomena, to be here-

after investigated by the progressing lights of organic chemistry and physiology.

46. The ordinal arrangement presented in the monographic delineations, and the facts precedently investigated, render it probable, at least, that the liver, as intimated before, is the specialized depuratory organ of the alimentary apparatus; the lungs the same of the general venous system; and the kidneys of the arterial.

47. The foregoing considerations also explain why "absorption" as a *specialized* function, has not here been included among the assimilative series. It is because the ends which it purposed to pursue, are adequately provided for by venosis. Wherever veins, or venosis exists, there also exists absorption. We cannot say the same of the lymphatics or of lymphosis. Some error has obtained upon this subject from the habit of confounding absorption, in the specialized or effete sense here understood, and which is so generally received, with a more general power, which is the apparent property of the whole organization—imbibition or transudation. This latter occurs wherever porosity obtains, influenced in organic bodies by the laws in general of *endosmose* and *exosmose*. In this sense, the pulmonic veins are "absorbents," seeing that their natural office is to imbibe oxygen gas; the systemic also, as they imbibe carbonic acid; the chyliferous, the elements of chyle; the lymphatics lymph; and so on with respect to every tissue through which aqueous or other particles are in any manner permitted to pass. But it is obvious that those which have been mentioned, do something more than imbibe or transude; something which is "*sui generis*," as it relates to each; by which they are also enabled to *transform*, as well as to move onward or circulate, the matters they have previously imbibed and transformed. It is in truth, this "*sui generis*" property, this *transforming* power, which alone entitles them to be distinguished as *specialized* functions, and to receive the physiological epithets by which they are designated. It is this property or power, too, which accounts for the uniform characteristics of blood, wherever found; and of lymph, the same; as well as of the other products of their respective organs or apparatus. It appears, then, that absorption, a term of such general acceptation, is one of vague and inde-

finite signification, often misleading by its ambiguity, and of greater or less simplicity of meaning, as it happens to relate to phenomena depending upon one or more of the agencies which have been explained; an additional reason for its exclusion.

48. In works on Physiology, *hæmatosis* is said to be the essential object of respiration. This needs remark. Hæmatosis, according to the principles which have been expounded, is the essential object of the chemical phenomena of respiration. This latter function is of a more comprehensive character, having in view the fulfilment of a double purpose. Respiration, as it appears, in the figured circle, is the antagonistical or opposite function to assimilation. It, nevertheless, has a relation to the cerebral functions, and constitutes the common bond which unites the animal with the organic man. Its relations, are, therefore, as we have said, two-fold: one having reference to the organic life, the other to the relative. The phenomena manifested by it, however, are of a three-fold character, to wit: chemical, physical, and mechanical. The first alone—the chemical—are those which directly relate to *hæmatosis*, consisting as they do of changes taking place simultaneously in the air of respiration and of the blood. This is of the order of organic life. The physical, or second, are of a different character, and consist of changes, confined to the air, affecting its volume or bulk only—the alterations in its quantity, produced by inspiration and expiration. These are changes having reference to vocal sounds, a series of functional phenomena directly relating to the relative life. The mechanical, or third, support the two preceding, and are the immediate means by which they are enabled to accomplish their respective ends. All of these require the presence of suitable objects to sustain them; objects having relations to each, as determinate as any of those which relate to the organs and functions which have been mentioned. One of the atmospheric constituents effects that purpose for the chemical, and the other for the physical and mechanical. Oxygen does it for the first; nitrogen for the second and third. Physiologists have hitherto been greatly perplexed to discover any obvious utility for the nitrogen. As it respects this function, it appears to them to be altogether neutral. But this is owing to their having sought for it where it was not

naturally to be found. Having failed in their explorations of the chemical, they should have inquired for it amidst the physical. As a supporter of inspiration, it is connected with the physical phenomena. It is destined to maintain the animal functions, not the organic, the life of relation not of nutrition.

49. The inspection of the chief figure, with a special regard to what has been said of the circumferential relations of the functions, explains, and in a satisfactory manner, too, perhaps, the mode of origin of many of the ills which are known to result from lesions of their organs. It explains the accumulations which are apt to take place in the blood, and consecutive diffusions in the body resulting from embarrassed *choleosis*, *ureosis*, *hæmatosis*, &c., the accumulation of bile from hepatic derangements; *urea*, from affections of the kidneys, or where they have been extirpated, as in the experiments of Prevost, and Dumas, and Segalas; and the various forms of dropsy, general and topical, from transudations into the cellular tissue and general cavities, arising from structural or other diseases of the heart.

50. The manner in which the lymphatic and lacteal systems are made to unite, before they pour their contents into the venous system, is not without an object. This, as well as the ends which the salivary and pancreatic secretions subserve in the economy, are dependent upon a principle well known to physiologists. Such is the natural repulsion existing between inorganic particles and organic entities, that the former cannot be assimilated by the latter, except by processes the most gradual and progressive. The danger of suddenly introducing foreign substances into the circulation, turns upon this principle. It can only be safely accomplished where this is managed by tardy steps. Otherwise assimilation becomes embarrassed, and death is not unfrequently the consequence. The consecutive relation of functions is designed to guard against this result, and is based upon this consideration. The rule pervades the entire series of organic phenomena, reaching from manducation to assimilation. It is manifested in the multifarious changes which the food is required to undergo, before it is fitted for the purposes of this latter function. Another principal office of the lymph, besides that already mentioned, in accordance with this exposition, there-

fore, would appear to be, the dilution of unassimilated matter by matter which has been assimilated. So also with respect to the saliva and secretion of the pancreas. The same law renders it necessary, that the pancreatic albumen should in like manner commingle with the albumen formed by the transforming agency of the chymifactive apparatus; that the product of a process purely chemical, before it be received into the chyliferous vessels, should be incorporated with one, otherwise of identical properties, which is the result of a distinctly organic operation.

